United States Naval Academy
Mechanical Engineering Department

EM461 Design and Analysis of Internal Combustion Engines

Catalog Description:EM461 Design and Analysis of Internal Combustion Engines
Credit: 3 (2-2-3)

The course objective is to provide a fundamental understanding of reciprocating internal-combustion engine design and operation. This is achieved by linking existing engine hardware design and performance analysis to concepts and disciplines studied in the mechanical engineering curriculum.

Prerequisites: EM320 Applied Thermodynamics
Corequisites: None

Textbooks: Heywood, John B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.

Course Director: Assistant Professor Paulius V. Puzinauskas

Objectives[1]:

1. To understand the basic function, design evolution and performance characteristics of modern internal-combustion engines and their components. (a, c)
2. To link engine hardware design and performance analysis to concepts and disciplines studied in the mechanical engineering curriculum. (a, b, c, d)
3. To familiarize and train students in engine performance testing techniques. (b, c)

Course Content:

No.	Topic or Subtopic	hrs.
	Introduction	1
	Engine Types and Classifications	5
	Thermodynamics Review	4
	Engine Design and Operating Parameters	4
	Engine Management	4
	Engine Flow	5
	Choice of:	
	Camshaft Analysis (or)	3
	Piston Design	3

Evaluation:

1. Quizzes	_X_ Yes	___ No
2. Homework	_X_ Yes	___ No
3. Exams	_X_ Yes	___ No
4. Laboratory Reports	_X_ Yes	___ No
5. Oral Presentations	_X_ Yes	___ No
6. Design Reports/Notebooks	___ Yes	___ No
7. Prototypes/Demonstrations	___ Yes	___ No
8. Projects	_X_ Yes	___ No

9. any other evaluation tools used ___ Yes ___ No

Acquired Abilities[2]:

1.1 The student will be able to describe the function of all major components and parts of an internal combustion engine. (1, 4, 5)

1.2 The student will be able to discuss the advantages and disadvantages of various engine configurations and design choice. (2, 5)

1.3 The student will be able to define or identify relevant mechanical, thermo-chemical, fluid mechanical parameters essential to design and energy analysis of internal combustion engines. (1, 2)

1.4 The student will be able to explain the effect of engine management operating set points and understand the optimization process for these set points. (4, 5)

2 The student will be able to perform mechanical, thermo-chemical, electrical and fluid dynamical analysis essential to the understanding of engine design and performance. (1, 3, 4, 5, 8) These include;

2.1 Dynamic force calculations on internal components,

2.2 First Law for reacting system calculations as related to in-cylinder combustion,

2.3 Ideal cycle thermodynamic analysis and comparison to actual engine data,

2.4 Available and required ignition energy calculation, and

2.5 Steady and transient flow in intake and exhaust systems.

3 The student will design, modify or interchange selected engine components and analytically predict and experimentally quantify the associated effect on engine performance. (8)

Date of Latest Revision: 10 OCT 2001

[1] Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Program.
[2] Numbers in parenthesis refer to the evaluation methods used to assess student performance.